Task Idea—Research Description
Research Action Plan Development
Template 1

National Research Program Area (e.g., ACE, CSS, etc)

SHC

Topic/Science Question

Developing Tools Support Community Sustainability (Theme 1)

Project

Research to Inform and Assess Decisions to Improve Community Public Health (Project 3)

Task Title:

Integrated Methods, Measurements, and Models (Output 2.1)

Primary Contact Name:

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Lab/Center

NHEERL/WED

Outputs from Project related to this task

This work will contribute to two of the project outputs: (i) cumulative risk research including chemical mixtures relevant to communities, and interactions and effects of non-chemical stressors (e.g., health impacts from climate change and loss of ecosystem services, the condition of the built environment, socioeconomic, and physical stressors) that may augment or attenuate adverse impacts of chemical stressors, and; (ii) Models (environmental- and human health-related) to quantify, track, and reduce cumulative public-health risks at the community level from exposures to multiple chemical, biophysical, and social stressors.

Rationale and research approach

Rationale

Zoonotic diseases such as plague, rabies, Ebola, Lyme disease, and others, present serious human health concerns. The prevalence of some zoonotic diseases is increasing, and this trend may be partly attributable to habitat loss, fragmentation, and human-induced modifications to natural disturbance regimes that impact wildlife communities. For example, researchers theorize that biodiversity often

disproportionately impacts incompetent wildlife host species, and can thereby promote the spread of vector-borne pathogens. In the case of Lyme disease, the anthropogenic disturbance lowering biodiversity involves adding people to the perimeters of natural areas, which simultaneously increases human-pathogen encounter rates. In general, the spread and dynamics of zoonotic disease result from complex interactions at the individual, population, and community level, and these interactions are linked spatially and temporally to habitat and disturbance patterns. Forecasting changes in the prevalence of zoonotic diseases can only be done properly with the aid of models that are individual-based, spatially-explicit, and that simulate the impacts of multiple interacting stressors on wildlife populations. Such forecasting is necessary to more fully understand the consequences of human activities for community health. This effort will develop and test one such forecasting model.

Approach

This task will use the model HexSim to illustrate how disease dynamics can change as a function of anthropogenic disturbance regimes. The example we propose to begin with involves the black-footed ferret, the prairie dog, sylvatic plague, and pesticides. The ferret is one of the most endangered species in the US. It depends on the prairie dog as a food resource, and both are highly susceptible to plague. Multiple ongoing human disturbances are modifying the dynamics of both animal species, with the application of pesticides used to control prairie dogs being an example of critical importance. Our study of this system will illustrate how the HexSim model can be used to better understand the dynamics between landscape structure, interacting populations, disease, and human disturbance. This study will also be linked to work involving HexSim that has been proposed under the CSS Multi-Year plan. Other case studies will also be pursued, once this initial model system has been developed.

HexSim is an extension of the PATCH simulation model, which was used in the analyses conducted for more than 30 peer-reviewed publications. HexSim has thus far been used to investigate the effects of land-use change and the synergistic effects of land-use and climate change, and it is currently being employed by the U.S. Fish and Wildlife service in the 2010 spotted owl recovery strategy. HexSim is also being used in a study of anticoagulant rodenticide impacts on the San Joaquin kit fox, under a cooperative agreement between ORD and the University of Washington.

Expected products from task

Multiple case studies illustrating how the HexSim model can be used to better understand the impacts that human disturbance has on zoonotic disease prevalence and distribution.

Collaborators (known or proposed)

Allen Brookes (Computer Scientist, NHEERL, WED)
Bob McKane (Ecologist, NHEERL, WED)
Nathan Schumaker (Ecologist, NHEERL, WED)
Others TBD

Number of FTE per year by L/C as provided by Division Management

1.0

Extramural Resources Estimate

TBD

Extramural Resource Details

TBD

Anticipated Start Date

2012

Anticipated End Date

2017

Milestones (not required)

TBD